Robust predictions of electromagnetic ratio observables from no-core configuration interaction (NCCI)

Patrick Fasano

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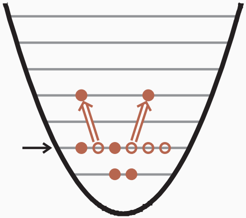
University of Notre Dame

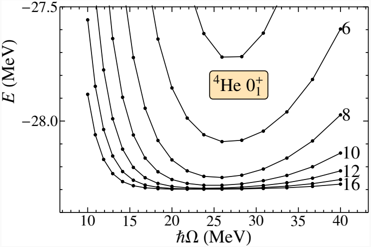
No-core configuration interaction (NCCI) approach

P. Navratil, J. P. Vary, and B. R. Barrett, Phys. Rev. Lett. **84**, 5728 (2000).

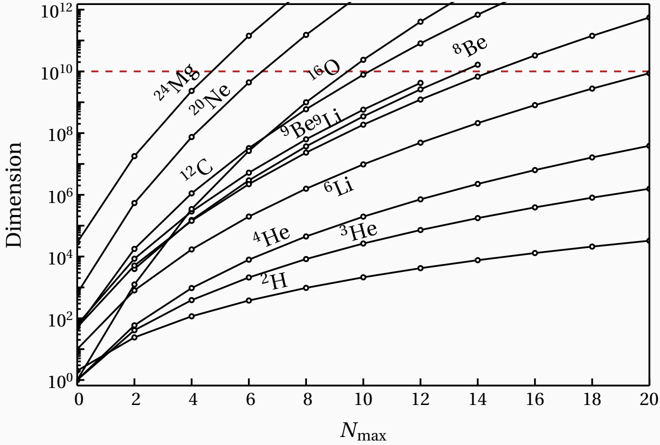
1. Begin with orthonormal single-particle basis: 3-dim harmonic oscillator
2. Construct many-body basis from product states (Slater determinants)
3. Basis state described by distribution of nucleons over oscillator shells
4. Basis must be truncated: N_{max} truncation by oscillator excitations
5. Results depend on truncation N_{max} — and oscillator length (or $\hbar\omega$)

Convergence towards exact result with increasing N_{max}

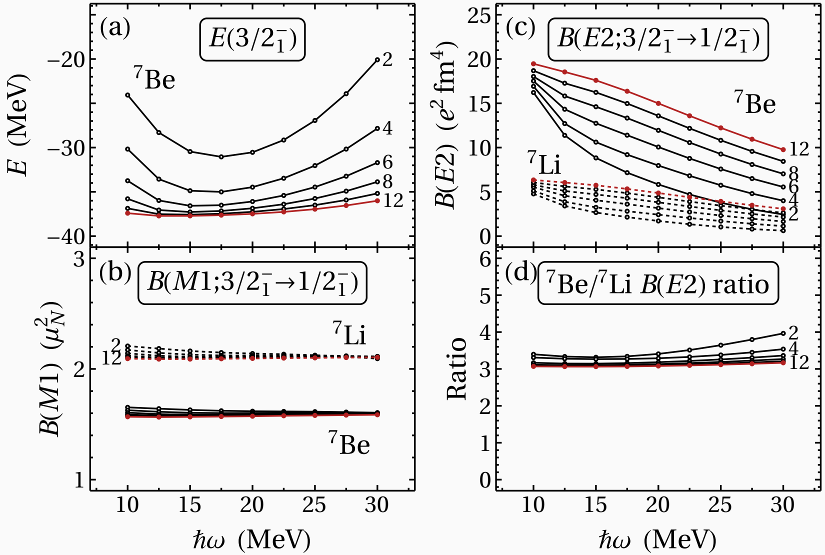




NCCI Basis Size

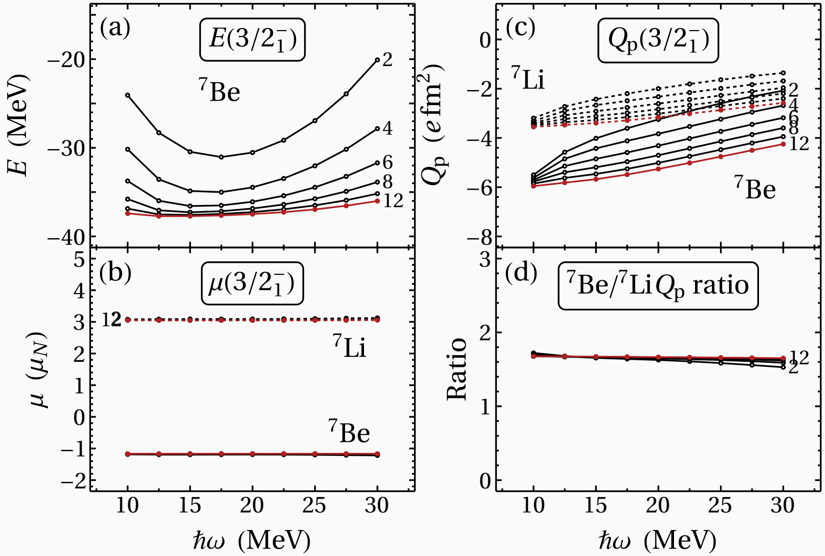


Convergence behavior of observable

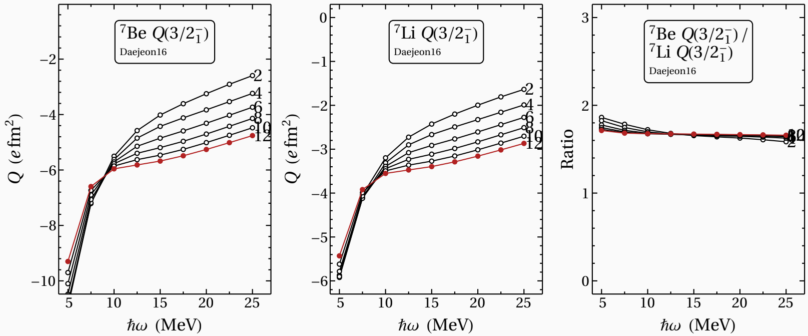


S. L. Henderson, T. Ahn, M. A. Caprio, **PJF**, et al., submitted to Phys. Rev. C

Convergence behavior of observables – moments



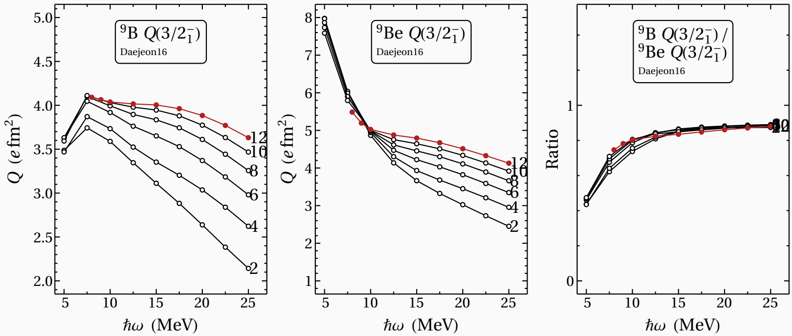
Ratio of ^{7}Be & ^{7}Li quadrupole moments



We have extracted a useful quantity! If we know Q_p for ^{7}Li, we can predict Q_p for ^{7}Be. Are the mirror nuclei in $A = 7$ a special case?

^{9}C	^{10}C	^{11}C	^{12}C
^{8}B	^{9}B	^{10}B	^{11}B
^{7}Be	^{8}Be	^{9}Be	^{10}Be
^{6}Li	^{7}Li	^{8}Li	^{9}Li

Ratios of quadrupole moments in other isobars



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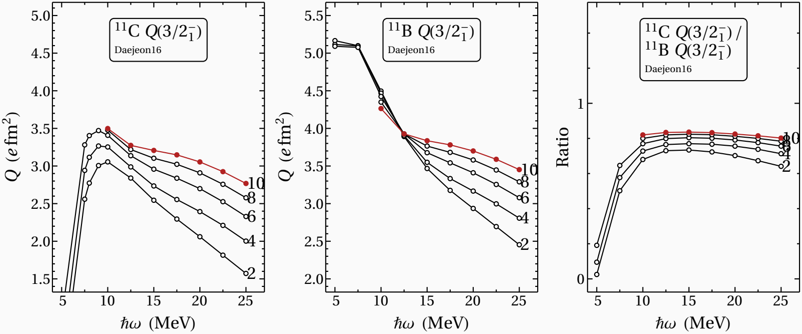

Are *mirror nuclei* a special case?

^{9}C	^{10}C	^{11}C	^{12}C
^{8}B	^{9}B	^{10}B	^{11}B
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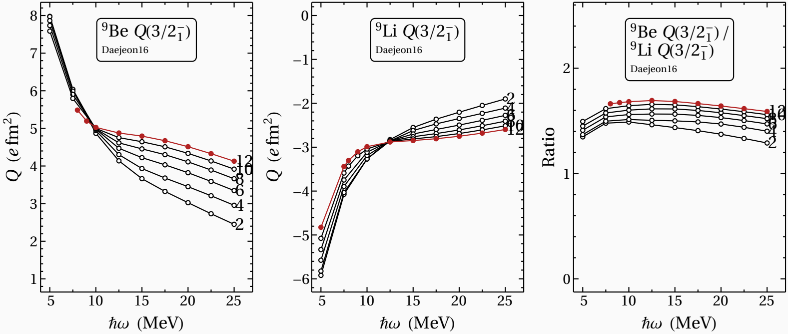

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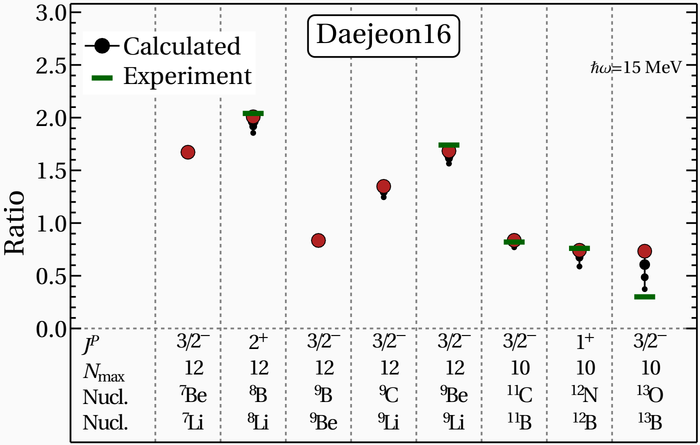
Summary

- Relative observables (ratios, differences, etc.) are an important way of circumventing convergence issues.
- Currently, we can take ratios to extract robust, testable predictions from unconverged calculations.
- Next steps are to understand where and why ratios are convergent, as well as where they fail.
  - Isobaric analogues?
  - Dependence on long-range tails?
  - Approximate symplectic symmetries?

Summary



Collaborators: *M. A. Caprio (ND), P. Maris (IA State), J. P. Vary (IA State), A. E. McCoy (TRIUMF)*